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ABSTRACT

This module was developed as remedial material for physics students who have difficulty understanding concepts of circuits and calculating resistances, and voltage drops and currents. Lists of prerequisite skills and instructional objectives are followed by a pretest (with answers). Students are directed to the subject matter in the module based on the number of and what questions were missed in the pretest. Objectives include defining the nature and operation of a battery; defining voltage, current, resistance, and direct current; calculating resistance; calculating current in a direct circuit; and calculating voltage output of a battery in a circuit. Prerequisite skills include understanding that an electron is a particle of negative charge orbiting around the nucleus of an atom, understanding that electrons are able to be removed from the atom and transferred to another atom (this movement of the electron's charge being called a current), and having the mathematical skills to complete correctly such problems as are found in the pretest. The module concludes with a 10-item posttest, indicating completion of the module if 2 or less items are incorrect and suggesting a review of topics missed if 4 or more questions are answered wrong. (Author/JN)

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DIRECT CURRENT SERIES CIRCUITS:

AN EDUCATIONAL MODULE

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SE039180

The following instructional module was prepared in partial fulfillment of the requirements for SE-3001 by the author, Keith Sturgess. As this module exemplifies a unique imaginative presentation of difficult content material, we, his instructors, encouraged the publication of the module in the hopes that other students and teachers might benefit from his efforts. Mr. Sturgess is responsible for the material contained herein unless otherwise indicated.

The Florida Institute of Technology refers all comments to the author.

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Single copies used for instructional purposes are permitted.

Keith Sturgess, Author
September, 1982

Statement of Purpose

This module will be used to remediate students in Physics who are having trouble with the concepts of circuits and calculating resistances, voltage drops and currents.

Prerequisite Skills

1) The student must have an understanding of the electron as being a particle of negative charge that orbits about the nucleus of an atom.

2) The student must understand that electrons are able to be removed from the atom and transfered to another atom, this movement of the electron's charge being called a current.

3) The student must have the mathematical skills to complete correctly such problems as is found in the pretest.

Instructional Objectives

1) The student will, in his own words, define what a battery is and what it does.

2) The student will, in his own words, define voltage.

3) The student will, in his own words, define current.

4) The student will, in his own words, define resistance.

5) The student will, in his own words, define what a direct current circuit is.

6) Given the formula and a question, the student will be able to calculate resistance.

7) Given the formula and a question, the student will be able to calculate current in a direct circuit.

8) Given the formula and a circuit, the student will be able to calculate voltage output of a battery in a circuit.

PRETEST

This pretest will measure your understanding of the ideas that will be covered in this module of instruction. By your results on this pretest, you will determine where to start in this module.

Given the formula $R = V/i$

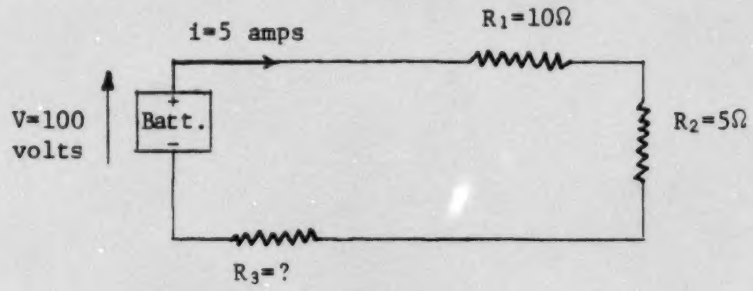
1. Find R if $V = 5$ and $i = 10$.
2. Find i if $R = 15$ and $V = 30$.
3. Find V if $R = 20$ and $i = 2.5$.

Given the formula $V - iR_1 - iR_2 = 0$

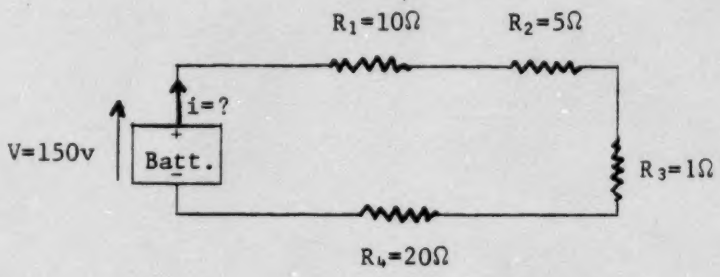
4. Find V if $i = 5$ and $R_1 = 3$ and $R_2 = 2$.
5. Find i if $V = 30$ and $R_1 = 4$ and $R_2 = 2$.
6. Find R_1 if $V = 40$ and $i = 5$ and $R_2 = 2$.
7. Find R_2 if $V = 100$ and $i = 10$ and $R_1 = 6$.
8. In your own words, define what a battery is and what it does.
9. In your own words define what voltage is, and what happens to it as it travels through a circuit.
10. In your own words define what current is and what happens to it as it travels through a circuit.
11. In your own words define what a resistor is and what resistance measures.
12. Define what a direct current series circuit is.

Pretest cont.

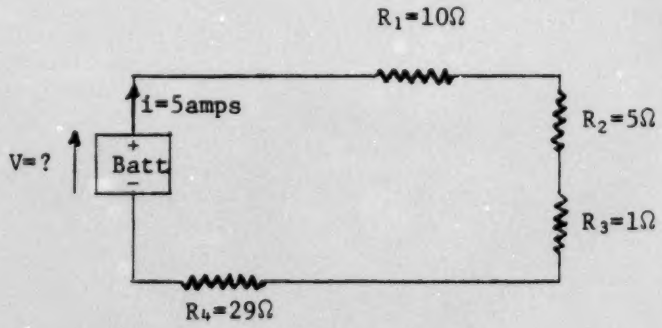
13. Given the circuit shown, calculate the unknown resistance.



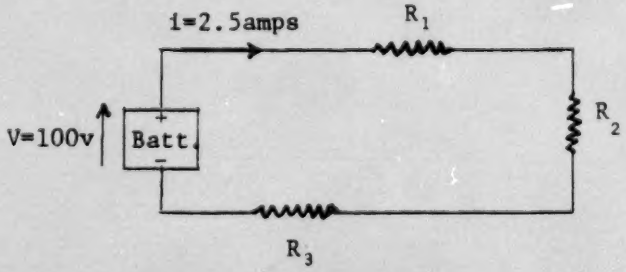
14. Given the circuit shown, calculate the unknown current.



15. Given the circuit shown, calcualte the unknown voltage.



16. Calculate the total resistance of the circuit shown, and then of each resistor if the resistance in R_2 is twice that of R_1 and R_3 is three times that of R_1.



Answers for Pretest

$R = V/i$

1. if $V = 5$ and $i = 10$ then $R = V=5/i=10$ so $\boxed{R = 5/10 = 1/2}$

2. if $R = 15$ and $V = 30$ then $R = 10 = V=30/i$ so $15 = 30/i$ by cross multiplication

   $\frac{15}{1} \times \frac{30}{i}$ $15i = 30$ so $\boxed{i = \frac{30}{15} = 2}$

3. if $R = 20$ and $i = 2.5$ then $R = 20 = V/i = 2.5$ so $20 = V/2.5$ by cross multiplication we get $\frac{20}{1} \times \frac{V}{2.5}$ so $20(2.5) = V$ or $\boxed{V = 50}$

4. if $i = 5$ and $R_1 = 3$ and $R_2 = 2$ then
   $V - 5(3) - 5(2) = 0$
   $V - 15 - 10 = 0$
   $V - 25 = 0$
   $\boxed{V = 25}$

5. if $V = 30$, $R_1 = 4$ and $R_2 = 6$ then
   $30 - i(4) - i(6) = 0$
   $30 - (4i+6i) = 0$
   $30 - (10i) = 0$
   $30 = 10i \Rightarrow \boxed{i = 3}$

6. if $V = 40$, $R_2 = 2$ and $i = 5$ then
   $40 - 5R_1 - 5(2) = 0$
   $40 - 5R_1 - 10 = 0$
   $30 - 5R_1 = 0$
   $30 = 5R_1 \Rightarrow \boxed{R_1 = 6}$

7. if $V = 100$, $i = 10$, $R_1 = 6$ then
   $100 - 10(6) - 10R_2 = 0$
   $100 - 60 - 10R_2 = 0$
   $40 - 10R_2 = 0$
   $40 = 10R_2 \Rightarrow \boxed{R_2 = 4}$

Answers cont.

Although answers may vary on these definitions, the answers given below should be somehow incorporated into the answers you gave in order to consider your answer correct.

8. It should be mentioned that a battery has a potential difference between the terminals which acts as a pump to move electrons throughout the circuit. Noteworthy is the fact that electrons are not stored in the battery.

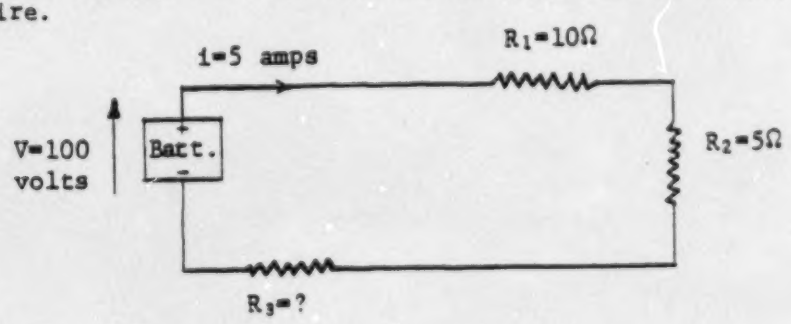
9. Voltage can be considered the "force" that moves the current through the circuit. As you move through the circuit, the voltage is used up in resistors and/or the wire itself so that when you check the voltage through the wire just before it enters the battery after it has traveled through the circuit, the voltage should approach zero.

10. Current is the movement of electrons through the wire. This movement of electrons is a net movement, being pushed by the battery attached. Currents are constant through a series circuit.

11. A resistor is any object that current can flow through and which uses up some potential difference or voltage. Resistance can be calculated by measuring the voltage drop across the resistor and the current through it: $R = V/i$.

12. A direct current series circuit is one in which the current flows in just one direction and which there are no places in which the current can go in more than one way. The current flows from a battery through any number of resistors (loads) and back into the battery with no branches or loops in the wire.

13.



This problem can be solved in two ways. The first is to find the total resistance of the circuit and then the unknown resistance. The second is to sum up all the voltages throughout the circuit knowing that it must equal zero.

(1) $R_{total} = V/i$

$R_{total} = \frac{100 \text{ volts}}{5 \text{ amps}} = 20 \text{ ohms}$

$R_{total} = R_1 + R_2 + R_3 \Longrightarrow 20 = 10 + 5 + R_3$

$20 = 15 + R_3$

$5 \text{ ohms} = R_3$

(2) $V - iR_1 - iR_2 - iR_3 = 0$

$100 - 5(10) - 5(5) - 5R_3 = 0$

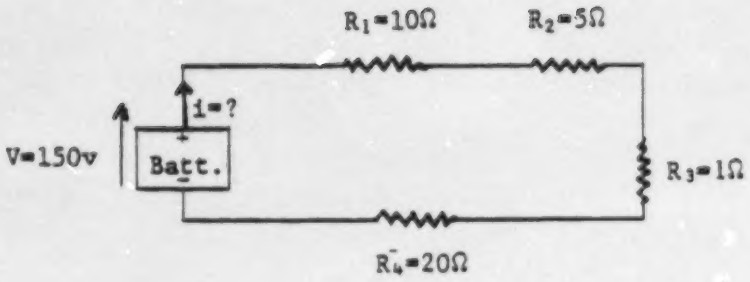
$100 - 50 - 25 - 5R_3 = 0$

$25 = 5R_3$

$5 \text{ ohms} = R_3$

Answers cont.

14.



This is easiest solved by summing the resistances and then calculating the current.

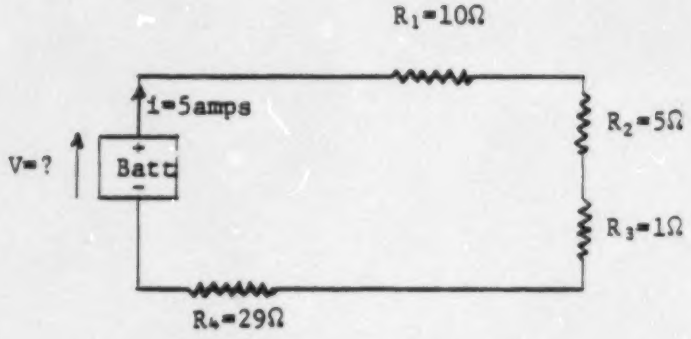
$R_{total} = V/i$

$(10 + 5 + 1 + 20) = 150/i$

$36i = 150$

$i = 4.17$ amps

15.



This is easiest solved by summing the voltage drops across each resistor and from that you know the voltage input.

$V - 5(10) - 5(5) - 5(1) - 5(29) = 0$

$V = 50 + 25 + 5 + 145$

$V = 225$ volts

or

$R_{total} = V/i$

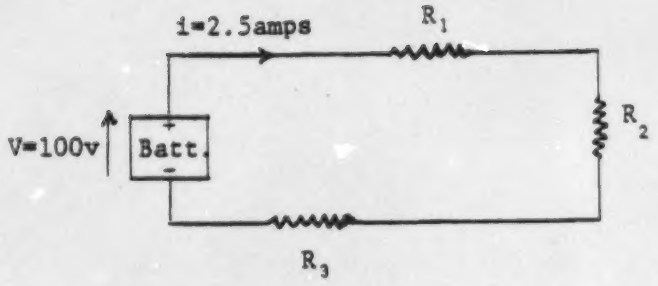
$V = iR_{total}$

$V = 5(10 + 5 + 1 + 29)$

$V = 5(45) = 225$ volts

Answers cont.

16.



R_{total} = 100/2.5 = 40 ohms

if R_2 is twice R_1 then $R_2 = 2R_1$

if R_3 is 3 times R_1 then $R_3 = 3R_1$

so

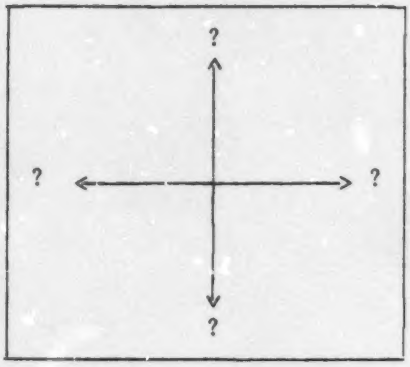
$R_{total} = R_1 + R_2 + R_3 \longrightarrow R_{total} = R_1 + 2R_1 + 3R_1$

40 ohms = GR_1

6.67 ohms = R_1

13.33 ohms = R_2

20 ohms = R_3



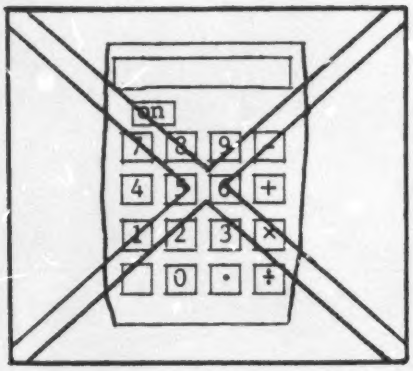
Where do YOU go from here?

(1) If you do not have the prerequisite skills #1 or #2, or if you missed more than one of the first 7 questions on the pretest then you need to see the teacher to get some extra help to develop these skills before you try this module.

(2) If you missed more than one of questions 8-12 or missed some points of each, then you need to start at the beginning of this module.

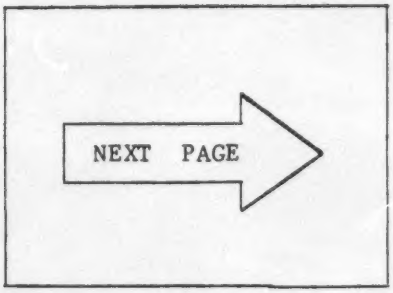
(3) If you missed more than one of the questions 13-16 but did complete 8-12 with no problems, then you may skip part I and go to part II.

(4) If you answered the entire pretest and missed less than 3 questions (one question from each part) then you already have the skills that this module teaches - so it is not necessary for you to complete this module.



WHAT DO I NEED?

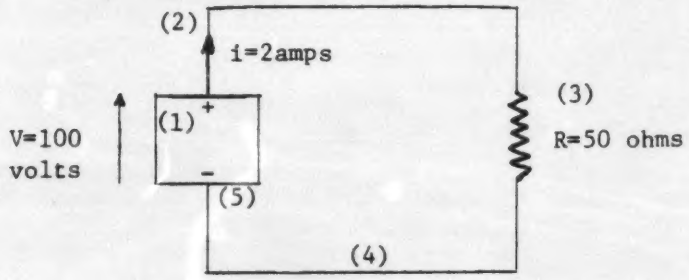
All you need to complete this module is a pencil, paper, and a BRAIN !!!!!



PART I

Before we can go into any depth in a conversation about direct current series circuits, it is necessary that we both have the same understandings about the terms we will encounter. To see that we both know these terms, I have enlisted the aid of an old friend and one time master, Mr. Buzz Littlebit. Buzz is unique among the studiers of electricity, for as his name implies, he is extremely small. So small, in fact, that he can get inside circuits and see first-hand what is going on. (Of course he wears his rubber-soled sneakers at all times, but that is another module.) Buzz has agreed to go into a circuit we set up and by the use of radios, tell us what he sees.

Here is the route Buzz will take.



"Are you ready, Buzz?"

"Quite so. I will enter at position 1 on the map, and so begin my trip in the battery. Make sure that you do not turn on the battery until I am ready to move on!"

"You've got it. Now tell us, Buzz, what do you see?"

"Right now there isn't much happening, but when you turn on the battery, things will start to hop in here. Tell all your friends out there that there are no electrons sitting in here waiting to get out; no, on the contrary, the battery does not store up electrons; it simply pushes them through the wire.

It might be easiest to think of a battery as being like a water pump; the pump moves the water through pipes, but the pump does not itself have any of the water that moves through the pipes. What the battery does do is to develop a positive charge on one terminal, and a negative charge on the other, which pulls the electrons already in the wire around the circuit . . . . . Okay, turn on the battery."

"Here you go, hang on Buzz!"

"Whecceee!!!"

"Buzz, are you all right?"

"Fine, fine. I just got hit with one of the first few electrons through and it pushed me to position 2. You know, you could think of this wire, or any conductor, as being like a tube full of marbles (the marbles being the electrons). As you push one electron (marble) in one side, out pops one on the other side."

"That's a great analogy Buzz. But tell me, how's the current?"

"Come on in, the current's GREAT! Ha Ha Ha. Just a little joke! Seriously, the current here is 2 amps and it will be 2 amps along my whole trip. The current would even be the same if we made the wires different sizes. Remember, current is the number of charges per unit of time, in my case, 2 coulombs per second, so if the wire got thinner the electrons would just flow faster; if the wire got fatter, the electrons would flow slower.

"So once we find the current in a circuit, is it always the same?"

"Yes my young friends, as long as you don't change the voltage of the battery or the resistance."

"Ah yes; could you tell us some about voltage?"

"Certainly. Voltage is the measure of the potential difference between two points. When we talk about a battery having 100 volts like ours for an example, it means between the positive and negative terminals there is a difference of 100 volts. This voltage can be thought of as a force that once the electrons are drawn into the battery to the positive terminal is used to force them to the negative terminal from whence they are shot out into the circuit. This force with which the electron starts out is slowly used up in the wire and in resistors so that by the time it gets back to the battery, the only thing that draws that electron to the battery is its attraction to the positive terminal."

"Okay uzz, let's move it along now. I think these people are getting bored by your ramblings. Where are you now?"

"Okay. Point taken. I'm at position 3 now, inside the resistor."

"Inside the WHAT?"

"Perhaps I should explain. A resistor is any conductor that will in any small way hinder the flow of current and so use up some of the force (volts) driving the electrons along."

"But even the wire does that."

"Ah yes, I remember well how intellectually stimulating our conversations of the past were. Yes, you are correct! To a small degree, even a wire is a resistor. Unlike the current though, the resistance of the wire will vary as its physical properties vary, such as length, cross section, temperature, and material."

"How so?"

"If the wire is thinner, it will take more force to push through the same number of electrons per second than it would if the wire was thicker. Naturally, the longer the wire the more the electrons must be pushed to get through, therefore, the higher the resistance."

"What else could be a resistor though?"

"Anything you put into a circuit has resistance - the lightbulb that is on now, the hairdryer you plug in, yes, even the battery has a small amount of resistance!"

"Moving on?!"

"Yes. Yes. Boy, going through that resistor took all the kick out of those electrons. Now we're just sort of gliding along, being pushed by the electrons behind us and pulled toward that positive terminal on the battery."

"Tell us, Buzz, just what is a direct current series circuit?"

"What in blazes do you think I'm riding in, a radish wagon?! A series circuit is one in which the electrons, and myself, have no choice in where we go. I start at point one and go through 2, 3, 4 and 5 no matter what. Kinda boring, actually."

"And direct current?"

"Simply means that the current is always going in one direction, like here, we go from the battery around the circuit and back into the battery."

"Are you ready to get out yet?"

"Yup, sure enough am. I don't mind helping you out once in a while, but use a lower voltage battery next time; those electrons nearly knocked me off my feet!"

"You bet, Buzz. Thanks a lot for the help. I learn something new every time we talk."

"You better sonny. You don't know everything yet. Ha Ha Ha! Now let's see how well the rest of you whippersnappers did at understanding me!"

WARNING:

QUIZ AHEAD

FORMATIVE CHECK

Select the correct choices for the multiple choice questions below. Try to not look back in the text, but if you cannot answer a question, feel free to look back.

1. In a direct current series circuit

   a. electrons flow in one direction only.
   b. the electrons flow through every part of the circuit.
   c. the current is constant.
   d. all of the above.
   e. none of the above.
   f. two of the above.

2. Voltage is

   a. the force needed to move the electron from the positive to negative terminal.
   b. used up in going through the circuit.
   c. measured in watts.
   d. all of the above.
   e. two of the above.
   f. none of the above.

3. Resistors in a series circuit

   a. are anything that resist the flow of electrons.
   b. can be added together to find the total resistance in the circuit.
   c. vary resistance with their physical characteristics.
   d. all of the above.
   e. none of the above.
   f. two of the above.

4. A battery

   a. is like a pump that moves electrons through the circuit.
   b. stores electrons up and then releases them when turned on.
   c. creates direct current.
   d. all of the above.
   e. two of the above.
   f. none of the above.

HOW WELL DID YOU DO?

Answers:

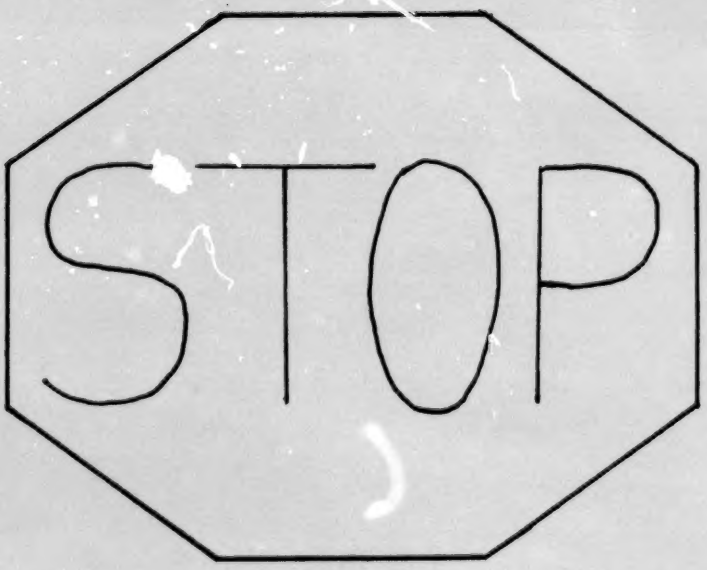
1. d

2. e

3. d

4. e

Look back to the module to find the answers to any questions you missed.



TAKE A BREAK. WHEN YOU FEEL SATISFIED

WITH PART I, CONTINUE ON TO PART II.

PART II

Hi! Buzz Littlebit and I would like to welcome you to Part II of direct current series circuits, the actual calculations involved in finding resistance, current and voltage. You now know what all of these terms mean, and should be ready to apply those definitions to problems, which is the whole point in learning about circuits.

"Buzz, how 'bout if I try my hand at explaining this, and you just step in when I get stuck?"

"Sounds like a good idea to me. Let's get started!"

"There are generally three possibilities for questions when you are given a series circuit. You could be asked to find: the current through the circuit (which we know from Part I to be constant throughout the circuit), the resistance of a resistor or of all the resistors, or the voltage applied by the battery or voltage drop across a resistor."

"That's right, sonny. Now tell them about Ohms Law so that these problems will be really easy."

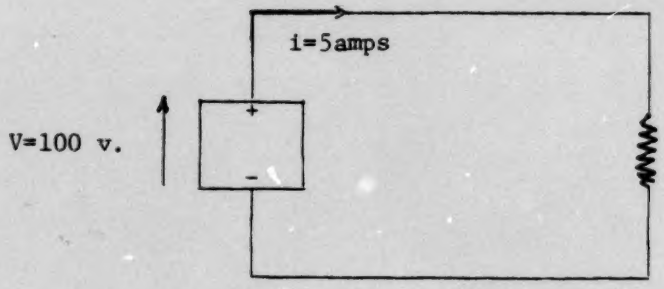
"Quiet down! I was just about to get to that. Ohms Law is a mathematical formula that relates all three of our variables: resistance, voltage, and current. It is written

$$R = V/i$$

where R is the Resistance, V is the voltage and i is the current in the circuit. Therefore, if you are given a circuit with only one resistor in it, you can calculate any of the above variables."

"Well, give them an example, boy!!"

"Alright, alright. Let's see, if you have the circuit shown below, what would be the resistance of the resistor?"



$$R = V/i = 100V/5amps = 20 \text{ ohms}$$

"What's that you say? Yes, that does work fine for a circuit with only one resistor, but how do you find the resistance if you have more than one resistor? Well, it's really pretty easy. We know that going through a resistor uses up some of the voltage that the battery applies. Further, we know that if there is only one resistor, that resistor must use up all of the voltage from the battery, because when the current gets back to the battery it should have zero volts. Well then, if you have two resistors, each must use a portion of the voltage, and so on with 3, 4, 5 or however many resistors you want. What we are saying can be expressed really well as a math formula.

$$R_{total} = R_1 + R_2 + R_3 + ...$$

It is also easy to see that by changing around Ohms Law of

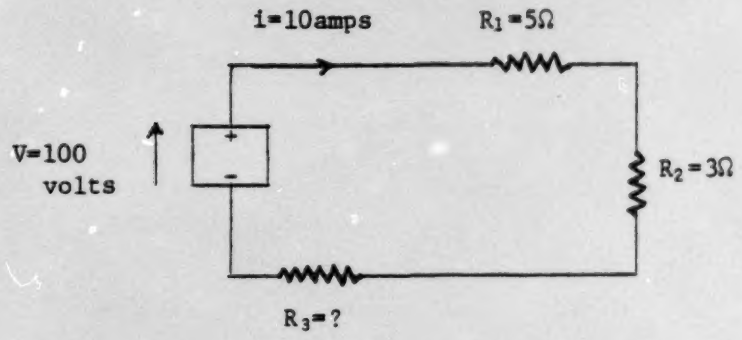
$$R = V/i$$

we can get:

$$V = iR$$

which is the voltage used up by each resistor.

Therefore, given the circuit below we can calculate resistance."



We can find Resistance in two ways with the above given information.

1) $R_{total} = V/i$

$R_1 + R_2 + R_3 = 100/10$

$5 + 3 + R_3 = 10$

$8 + R_3 = 10$

$R_3 = 2$ ohms

OR

2) Remembering that the voltage is 100 volts going into the battery and 0 volts entering the battery .....

voltage battery puts out = voltage resistors use

$100\text{volts} = iR_1 + iR_2 + iR_3$

$100v = 10(5) + 10(3) + 10R_3$

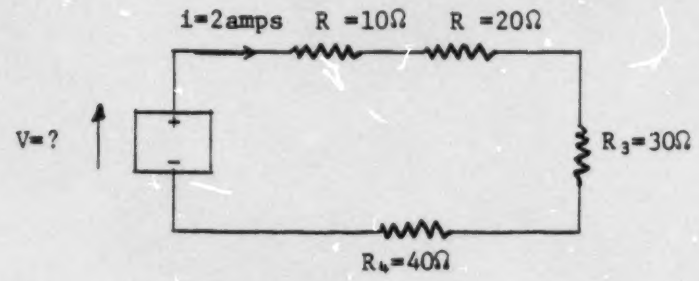
$100v = 50 + 30 + 10R_3$

$20v = 10R_3$

$2\text{ ohms} = R_3$

"Not bad, sonny. And giving them a choice of two methods . . . I like that. But WHAT ABOUT VOLTAGE AND CURRENT!?"

"Okay Buzz, hold your horses. We have all the basics now, there aren't any new formulas to learn, all we have to do is apply the formulas we already know. For voltage, for example, a question might look like what you see at the top of the next page.



$R_{total} = V/i$

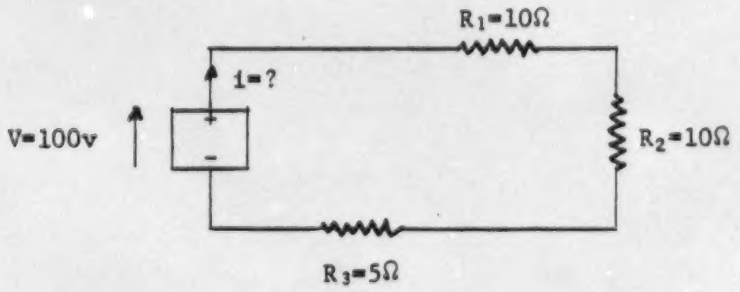
$iR_{total} = V$

$2(10 + 20 + 30 + 40) = V$

$2(100) = V$ so $V = 200$ volts

"Certainly now you could also add up all of the voltage drops across all of the resistors, which would equal the voltage output of the battery. The final type of voltage problem would ask you to find the voltage drop across one of the resistors. Well, we know that the voltage drop is equal to the current going through the resistor times the resistance of the resistor, or:

$$V = iR$$



What is the voltage drop in Resistor 3?

First we must calculate the current in the circuit so that we can use the equation $V = iR_3$.

To find current we use Ohms Law.

$R_{total} = V/i$

$R_1 + R_2 + R_3 = 100/i$

$10 + 10 + 5 = 100/i$

$25 = 100/i$

$25i = 100$

$i = 4$ amps

so now we can find voltage drop through R_3

$V_3 = iR_3$

$V_3 = 4$amps (5 ohms)

$V_3 = 20$ volts used up in Resistor 3

"Not a bad job, sonny. Can they look back through this before they go on to the quiz?"

"SURE! AT THIS TIME, REVIEW PART II FOR THE UPCOMING QUIZ!"

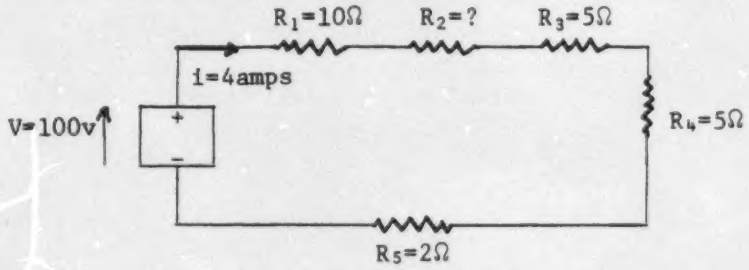
W A R N I N G :

QUIZ AHEAD

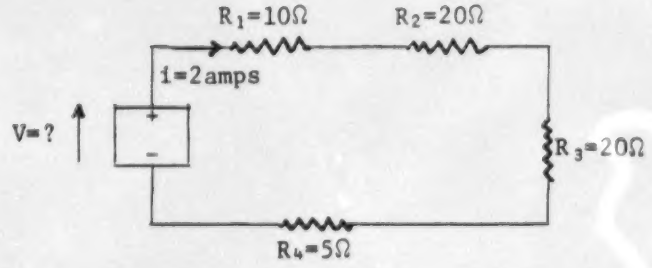
PART II QUIZ

WHEN YOU HAVE COMPLETED THIS QUIZ, GO TO THE NEXT PAGE TO CHECK IT!

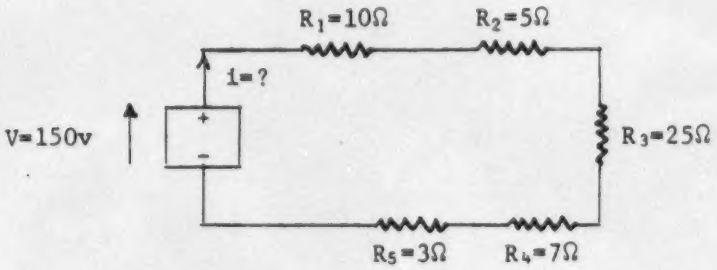
1. Calculate the unknown resistance shown.



2. Calculate the unknown battery voltage.



3. Calculate the voltage drop through R_3.



PART II - ANSWERS

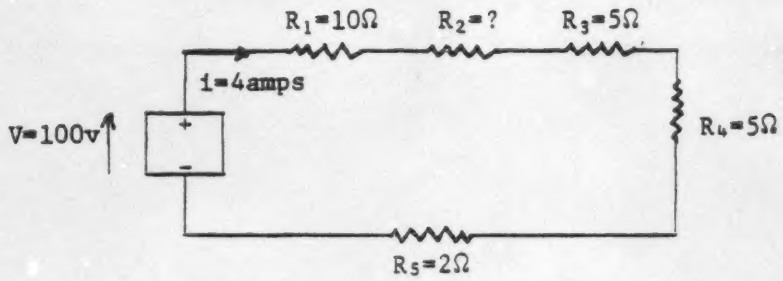
1. By Ohm's Law

$R_{total} = V/i$

$10 + 5 + 5 + 2 + R_2 = 100/4$

$22 + R_2 = 25$

$\boxed{R_2 = 3 \text{ ohms}}$



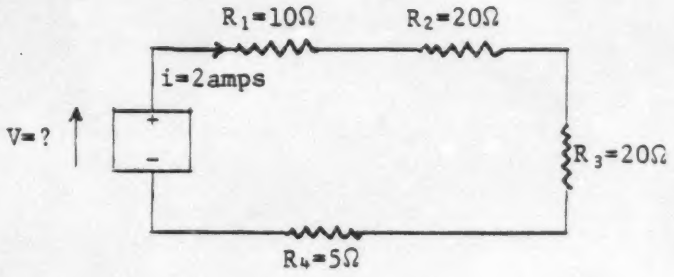
2. By Ohm's Law

$R_{total} = V/i$

$iR_{total} = V$

$2(10 + 20 + 20 + 5) = V$

$2(55) = V \longrightarrow \boxed{V = 110 \text{ volts}}$



3. First we must find the current by Ohm's Law.

$R_{total} = V/i$

$10 + 5 + 25 + 3 + 7 = 150/i$

$50 = 150/i$

$50i = 150$

$i = 3 \text{ amps}$

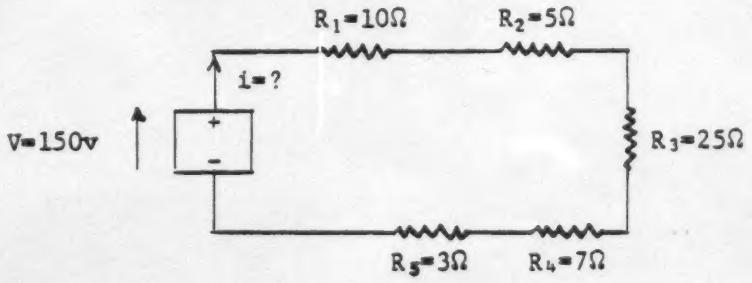
*****

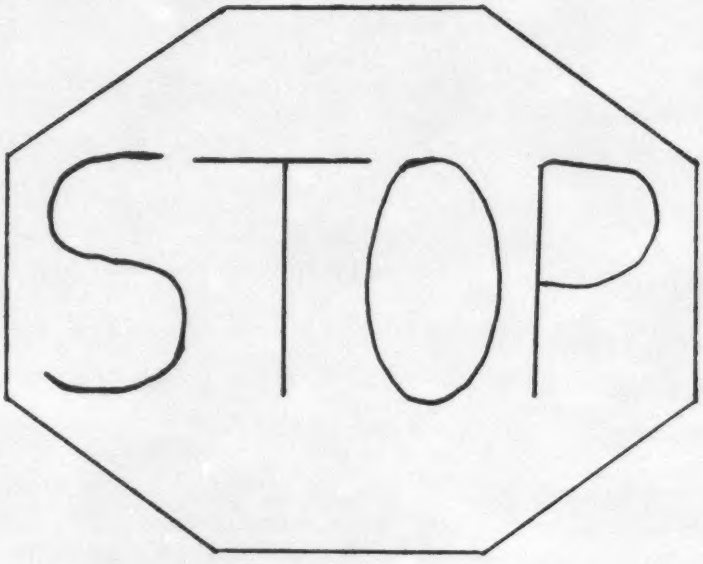
The voltage drop across R_3

$V_3 = iR_3$

$V_3 = 3(25 \text{ ohms})$

$\boxed{V_3 = 75 \text{ volts}}$





IF YOU MISSED ANY OF THE QUIZ QUESTIONS GO BACK AND REVIEW. IF NOT, YOU ARE READY FOR THE POST TEST.

W A R N I N G :

POST TEST ON NEXT PAGE

You have now come to the end of the module on direct current series circuits. It is time now to test to see how much you have learned. All you will need for this test is a pencil and determination.

POST TEST

Correctly answer the questions below and then go to the end of this module to find the answers and explanations.

1. The resistance of a wire at constant temperature depends on the wire's

   a. length only.
   b. type of metal only.
   c. length and cross-sectional area only.
   d. length, cross-sectional area and type of metal.

2. Current in a direct current series circuit is always

   a. measured in amps.
   b. constant value.
   c. changing value throughout the circuit.
   d. measured in amps and a constant value.

3. Voltage in a D.C. series circuit

   a. can be supplied by a battery.
   b. decreases throughout the circuit.
   c. is used up by resistors.
   d. all of the above.
   e. none of the above.

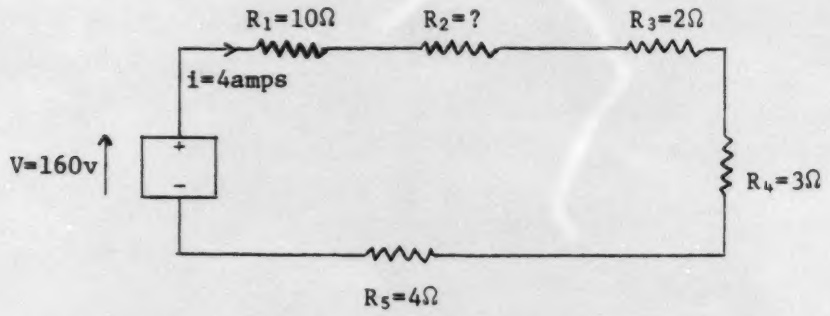
4. A battery

   a. supplies electrons.
   b. pumps electrons already present in the wire.
   c. provides alternating current.
   d. pushes electrons from the positive to the negative terminal with a force measured in volts.
   e. all of the above.
   f. two of the above.
   g. none of the above.

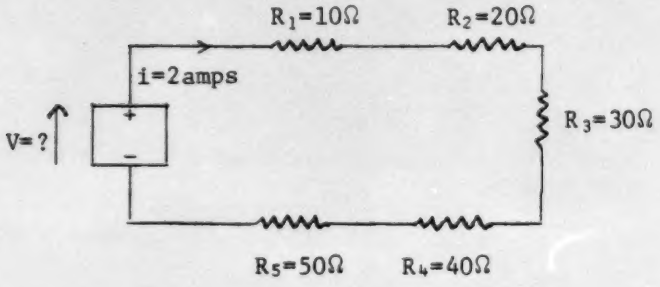
5. In a direct current series circuit

   a. the electrons move in the same direction always.
   b. electrons move through every part of the circuit every round trip they make.
   c. current is constant.
   d. all of the above.
   e. none of the above.

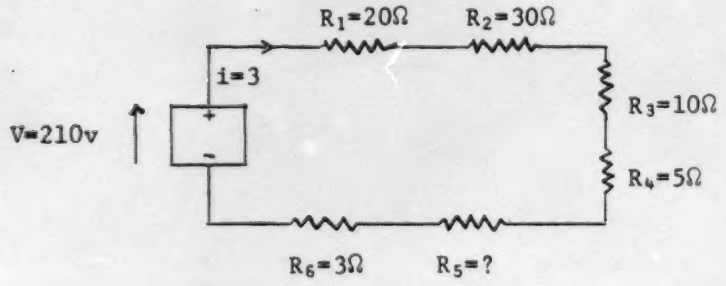
6. Calculate the resistance of the unknown Resistor$_2$.



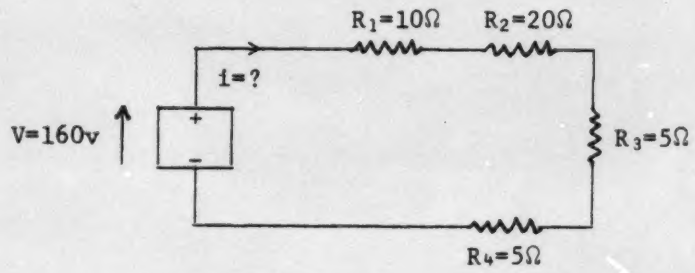
7. Calculate the voltage output of the battery?



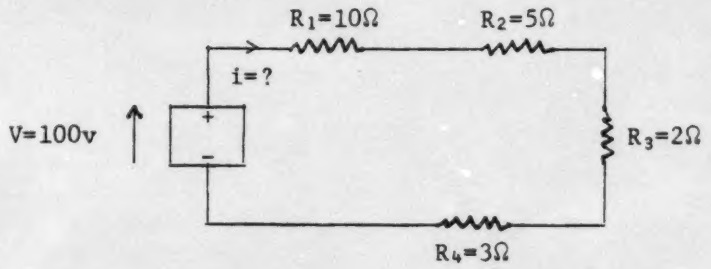
8. Calculate the total resistance of the circuit.



9. Calculate the current in the circuit.



10. Calculate the voltage drop across R_2.



ANSWERS TO POST TEST

1. (d). Resistance in a wire varies with its physical properties of temperature, length, cross-sectional area and type of metal.

2. (d). Current is always a constant value and it is measured in amps or fractions of amps.

3. (d). Voltage in a DC circuit can be supplied by a battery, decreases throughout the circuit due to its being used up by resistors.

4. (f). A battery acts as an electron pump and pumps the electrons from the positive terminal to the negative with a force, and that force is the voltage of the battery.

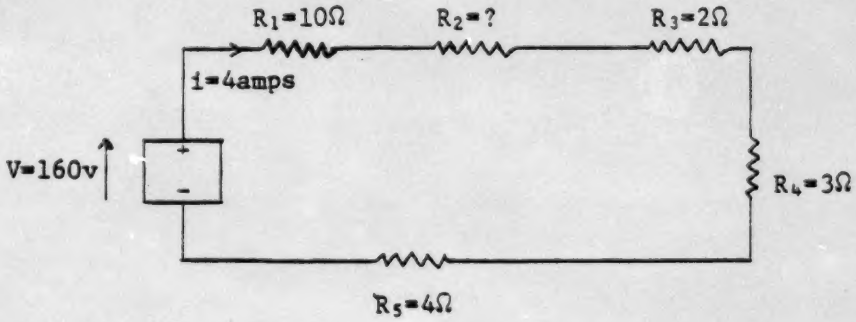
5. (d). Direct current means that the electrons go in a direct path around the circuit, and they move in the same direction. Of course, as above, the current is constant.

6. $R_{total} = V/i$

$10 + R + 2 + 3 + 4 = 160/4$

$19 + R_2 = 40$

$\boxed{R_2 = 21 \text{ ohms.}}$

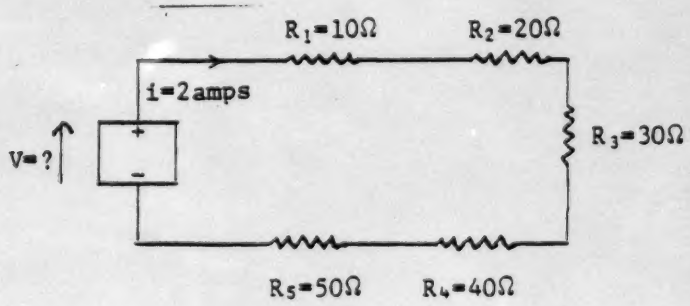


7. $R_{total} = V/i \Longrightarrow V$

$iR_{total} = 2(10 + 20 + 30 + 40 + 50)$

$2(150) = 300 \text{ volts}$

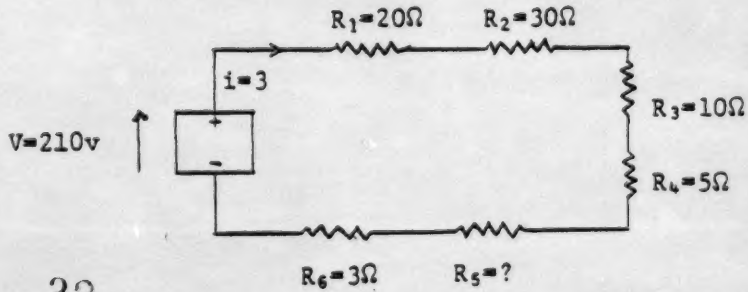
$\boxed{V = 300 \text{ volts}}$



8. $R_{total} = V/i$

$R_{total} = 210v/3amps$

$\boxed{R_{total} = 70 \text{ ohms}}$



Answers . . . cont.

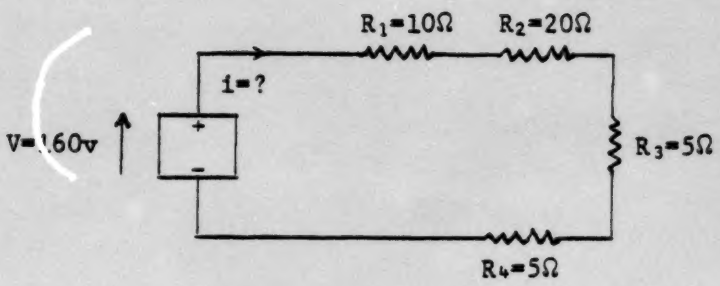
9. $R_{total} = V/i$

$10 + 5 + 5 + 20 = 160/i$

$40 = 160/i$

$40i = 160$

$\boxed{i = 4 \text{ amps}}$



10. First, find the current

$R_{total} = V/i$

$10 + 5 + 2 + 3 = 100/i$

$20 = 100/i$

$20i = 100$

$i = 5 \text{ amps}$

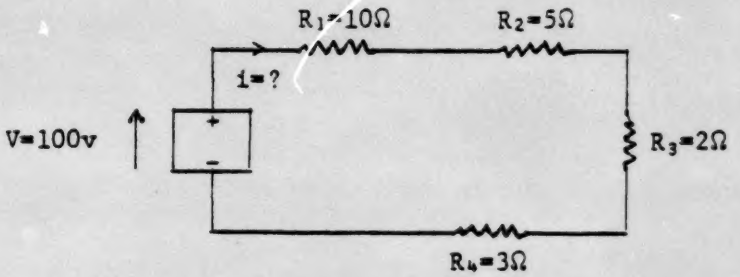
* * * *

Voltage drop through R_2

$V_2 = iR_2$

$V_2 = 5 \text{ amps (5 ohms)}$

$\boxed{V_2 = 25 \text{ volts}}$



N O T E

IF YOU GOT LESS THAN 2 QUESTIONS WRONG, YOU HAVE FINISHED THIS MODULE!

IF YOU GOT 4 OR MORE QUESTIONS WRONG, YOU NEED TO GO BACK AND REVIEW THE TOPICS YOU MISSED AND THEN TAKE THE POST TEST AGAIN.